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Determination of goat milk cost and assessment of factors affecting the profitability of Saanen goat enterprises in Çanakkale province, Turkey

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Abstract: The aim of this study is to determine the cost of goat milk in Saanen goat enterprises in Çanakkale province and to examine the factors affecting profitability in enterprises. The material of the study consists of 92 Saanen goat enterprises. The enterprises have been grouped according to their animal density; as 25-75 heads (small-scale), 76-150 heads (medium-scale) and 151 heads and above (large-scale). The findings of the enterprises for 2017 were determined by descriptive statistics, and multiple regression analysis was used to determine the factors affecting the total profitability of the enterprises. Since feed costs represented 46.22% of total production cost, it was followed by labour costs (27.19%), fuel costs (5.44%) and veterinarian-health service costs (5.19%). The cost of 1 L milk and absolute profit in enterprises was determined as 0.42/0.01 $/kg in small-scale, 0.41/0.02 $/kg in medium-scale and 0.38/0.05 $/kg in large-scale enterprises, respectively. It was observed that the share of inputs in enterprises generally decreases as the scale of the enterprise increases and large-scale enterprises were found to be more successful in solving technical, health and economic problems.

Keywords: Cost of milk, dairy goat, economic analysis, profitability, Saanen goat.

Çanakkale ili Saanen keçi işletmelerinde keçi sütü maliyetinin saptanması ve işletmelerde kârlılığa etki eden faktörlerin değerlendirilmesi

Özet: Bu çalışmanın amacı; Çanakkale il ve ilçelerindeki Saanen keçisi işletmelerindeki keçi sütü maliyetinin hesaplanması ve işletmelerde kârlılığa etki eden faktörlerin incelenmesidir. Çalışmanın materyalini 92 adet Saanen keçisi işletmesi oluşturmaktadır. İşletmeler sahip oldukları hayvan yoğunluğuna göre; 25-75 baş (küçük), 76-150 baş (orta) ve 151 baş ve üzeri (büyük) işletmeler olarak gruplandırılmıştır. İşletmelerin 2017 yılına ait bulguları, ortalama, yüzde, dağılım gibi tanımlayıcı istatistikler ile belirlenmiş, işletme toplam kârlılığında etkili faktörlerin saptanması amacıyla ise çoklu regresyon analizi kullanılmıştır. İşletmelerde maliyeti oluşturan unsurların %46,22'sini yem masraflarının, bunu sırasıyla işçilik (%27,19), akaryakıt (%5,44) ve veteriner-sağlık hizmet masraflarının (%5,19) oluşturduğu belirlenmiştir. İşletmelerde 1 L sütün üretim maliyeti ve mutlak kâr sırasıyla küçük ölçekli işletmelerde 0,42/0,01 $/kg, orta ölçekli işletmelerde 0,41/0,02 $/kg ve büyük ölçekli işletmelerde 0,38/0,05$/kg olarak saptanmıştır. İşletmelerde girdilerin payının genelde işletme ölçeği büyüdükçe düştüğü, teknik, sağlık ve ekonomik sorunların çözümünde ve kârlılık oranlarında büyük ölçekli işletmelerin başarılı olduğu saptanmıştır.

Anahtar sözcükler: Ekonomik analiz, kârlılık, Saanen keçisi, süt keçisi, süt maliyeti.

Introduction

Goats are animals that can make good use of low quality pasture and scrubland and turn it into meat, milk and other products (17). It is usually known as a traditional livestock breeding activity that forms the livelihood and essential food source of low-income families in rural areas (22). Animal products produced from goat breeding also contribute significantly to the national economy in terms of adequate and balanced nutrition of the growing population, supply of raw materials for industry and the revenues provided through exports (27). Goat milk production in Turkey is derived from the vast majority of hair goats. While 98.30% of 5 471 086 head goats milked in 2019 were hair goats, 99.40% of 577 209 tons of milk produced was obtained from hair goats (30).

In recent years in the Western Anatolian region, the activities of intensive enterprises, which mainly produce cheese and provide milk to dairies, are becoming

widespread. The breed used in these enterprises is generally high Saanen hybrids in terms of milk yield (22). Saanen goat breeds compliance with certain regions of Turkey has been provided and a very good and high milk yield has been achieved (16). Çanakkale is the province where Saanen goat breeding is intensively carried out and the number of animals is higher. In fact, 25.51% of the total of 852 871 head of Saanen goats in Turkey is located in Çanakkale province (5).

Dairy goat breeding activities are mostly based on small-scale and scattered family enterprises in Turkey (23). The utilization rate of advanced technology and qualified workforce is usually higher in large-scale enterprises. It is supported with many studies that enterprises work more profitably and cost-effectively with the increase in the scale (1, 15, 28). The technical and economic analysis of dairy goat enterprises have been handled within the scope of different provinces, and it is seen that these studies mainly focus on the hair or mohair goat enterprises (4, 6, 7, 11, 13, 28). Although studies analyzing the cost of unit goat milk and profitability in enterprises are limited, studies in this area are important in terms of determining appropriate enterprise scales and ensuring sustainability in the sector.

In this context, the aim of this study is to calculate the unit cost of goat milk in Saanen goat enterprises in Çanakkale province and districts and to examine the factors affecting profitability based on the enterprise scales.

Materials and Methods

Study area, selected enterprises and questionnaire structure: The primary data was obtained from Saanen goat enterprises which were registered in the system of Ministry of Agriculture and Forestry and members of Sheep and Goat Breeders' Association of Çanakkale province by using a questionnaire.

Çanakkale province is located in the west and coast side of Turkey (Figure 1) and is generally characterized by "dry-summer subtropical" climate that referred to as "Mediterranean". The mean annual temperature of Çanakkale is between 3° and 10 °C. Summers are dry and hot with mean 18° and 24°C. The average yearly rainfall is 618 mm (26, 29).

The owners who want to benefit from the animal support system must have 25 or more animals. For this reason, enterprises with 25 heads or more goats were included in the sampling in terms of both a good evaluation of production records and reliable data supply. In determining the sample, the average of each stratum and variance weights were taken into account using the simple random sampling method, and a single sample volume was determined for all strata (25).

Because the size of the population is known;

$$n = \frac{N.\sigma^2.Z\alpha}{(N-1).d^2}$$

N = 801 enterprises were included in the formula, and n = 87 enterprises were determined as a sample in the range of 1.55 standard deviations.

The distribution of enterprises in the sample by districts and scales was given in Table 1. The sample size consisted of 92 enterprises including back-up enterprises obtained by simple random sampling method. The enterprises were grouped as 25-75 heads (small-scale), 76-150 heads (medium-scale) and 151 and overheads (large-scale) according to their animal density. To provide the assumptions of statistical analysis from each scale in enterprises, at least 20 and more enterprises were included in the sample. The fieldwork was carried out in 2017-2018, covering the data of the year 2017.

Table 1. Distribution of enterprises in the sample by districts and scales.

District	Small	Medium	Large	Total
Ayvacık	1	2	2	5
Bayramiç	8	17	9	34
Biga	2	2	1	5
Çan	1	-	-	1
Ezine	3	6	7	16
Lapseki	2	3	3	8
Merkez	3	12	8	23
TOTAL	20	42	30	92

Figure 1. Display of study area.

Saanen goat enterprise owners were interviewed face-to-face, and a data supply form was applied to all 92 Saanen goat enterprises. In order to determine the data that will constitute the economic analysis, the amount and price information of the cost factors that constitute the unit cost of the milk, as well as questions regarding income factors, amount of milk produced and the sales price were included in data supply form.

Calculation of unit milk cost and profit: Unit milk cost was calculated according to the combined cost calculation method. For this, firstly, the costs per milk were determined in total production. The share of milk in the gross production value (main product + by-product value) was taken into account. Milk incentive premium and supports (supports for breeding goats between 15-90 months of age and supports comes from the National Sheep & Goat Breeding Project) were deducted from the production cost per milk, the remaining value was divided by the total amount of milk obtained at the end of a production period, and the cost of unit milk (with considering supports) was calculated (15). Absolute profit was obtained by subtracting the unit cost from the milk sales price, and proportional profit was obtained by dividing the absolute profit by the milk sales price (15).

Statistical analysis: SAS / STAT (Inst.Inc., Cary, NC), XLSTAT (Addinsoft, New York, NY) and SPSS Inc PASW Statistics 18 package programs were used in the analysis of the data. Descriptive analysis consisting of frequency, percentage and average was applied, and the correlations between the variables were examined. Whether the difference between group averages is significant was determined by using Variance Analysis (ANOVA). In hypotheses, independent variables were formed by scale groups, while dependent variables consisted of 1 L milk cost, milk yield per animal, producer milk sales price, total milk production, absolute profit, proportional profit, the income of milk sales and duration of the lactation period.

Regression Analysis: Multiple regression analyzes were conducted in order to analyze the input-output relationships of the enterprises for the production period in 2017. The formula where x_i indicates independent variables and Y indicates dependent variable was set up as follows:

$$\mathbf{Y_i = a_0 + a_1x_{i2} + a_2x_{i2} + \ldots + a_kx_{ik} + e_{ij}}$$

i = 1,2, …n j= 1,2…k

In formula;

Y_i: The observed i-th value of the dependent variable

X_{ij}: The value of the j-th independent variable at level i

a_j: j-th regression coefficient

e_{ij}: Error term

k: It refers to the number of independent variables.

The backward method was applied in the regression model. In the first stage, all variables were included. The process has been continued discarding the independent variable with the lowest partial F value in the following steps (20).

One of the most important problems encountered in the multiple regression model is whether there is a strong relationship (multiple correlations) between the independent variables included in the model (3). A correlation of 0.80 and above between the independent variables was considered as an indication of multiple correlations between variables, and this is undesirable (19).

Durbin Watson value, which explains whether there is an autocorrelation between terms in the model, is expected to be between 1.5-2.5 coefficients (18). However, VIF values indicating whether there are multiple correlations in the model are expected to be below 10 (9). Therefore, these points have been taken into account while including variables.

The model where the scales were considered as a dummy variable is as follows:

$$\mathbf{Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + a_{10}x_{10} + a_{11}x_{11}}$$

The dependent variable (Y) expresses the total profit obtained from milk sales income in US dollars.

Independent variables in the model was determined as feed costs (x_1), labour costs (x_2), veterinarian and health services costs (x_3), electricity-water costs (x_4), fuel costs (x_5), building-equipment maintenance and amortization costs (x_6), other costs such as credit interests, insurance costs, general administrative costs (x_7), 1 Lt milk cost (x_8), producer milk sales price (x_9) and small & medium scale (x_{10}), medium & large scale (x_{11}) as a dummy variable.

Results

Table 2 shows that the feed costs were the main cost factor in the enterprises with a ratio of 46.22%. Labour costs, fuel costs and veterinarian and health services costs were followed by respectively, with the rate of 27.19%, 5.44% and 5.19%.

Table 3 shows that the main component of the sub-income factors across enterprises was the increase in inventory value with the ratio of 51.53%. Goat kids sales, other incomes and cheese sales were followed by respectively, with the rate of 20.29%, 9.91% and 9.60%.

Table 4 presents the distribution of the values related to producer milk sales prices, 1 Lt milk cost and profit/loss in enterprises by scales. Producer milk sales price was found to be 0.44 $/kg while 1 Lt milk cost as 0.41 $/ kg. While milk sales income was 15 495 $ on average absolute profit was 0.03 $ / kg, and proportional profit was 6.68%. It was observed that the cost of production of 1 L of milk decreases as the enterprise scales increase. In contrast, enterprise profitability was found to be directly proportional to the enterprise scales (Figure 2).

The results of some milk production and yield values were evaluated based on the variance analysis (ANOVA). According to the results of the test, the difference between total milk production, milk sales income and lactation times in the enterprises was found significant in terms of scales ($P < 0.05$) (Table 4).

Table 2. Distribution of cost factors in enterprises by scales.

	Enterprise Scales			
	Small	**Medium**	**Large**	**Total**
Cost Factors	**%**	**%**	**%**	**%**
Feed Costs	39.44	46.96	49.73	46.22
Veterinarian and Health Services Costs	4.62	4.93	5.95	5.19
Labour Costs	33.86	28.19	20.98	27.19
Electricity, Water Costs	1.08	1.06	1.00	1.04
Fuel Costs	6.75	5.04	5.26	5.44
Insurance Costs	0.27	0.52	1.71	0.85
Credit Interests	0.99	0.92	1.93	1.26
Inventory Value Loss	1.67	0.41	0.00	0.55
Building Equipment Depreciation Costs	2.90	3.23	3.80	3.33
Building Equipment Maintenance and Repair Costs	3.47	2.71	2.58	2.82
Live Fixture Depreciations	2.25	3.38	4.46	3.48
General Administrative Costs	2.66	2.64	2.59	2.63
TOTAL	100	100	100	100

Table 3. Distribution of sub-income factors in enterprises by scales.

	Enterprise Scales			
	Small	**Medium**	**Large**	**Total**
Sub-Income Factors	**%**	**%**	**%**	**%**
Goat Kids Sales	25.46	18.47	19.40	20.29
Fertilizer Sale	2.13	0.55	0.93	1.02
Inventory Value Increase	45.15	52.79	54.01	51.53
Breeding Animal Sales	9.65	5.67	9.13	7.66
Other Incomes	6.95	11.03	10.31	9.91
Cheese Sales	10.66	11.51	6.22	9.60
TOTAL	100	100	100	100

Table 4. Distribution of average data and statistical comparison on some variables between enterprise scales.

	Enterprise Scales					
Variables	**Small**	**Medium**	**Large**	***Total***	***F***	***P value***
1 L Milk Cost ($/kg)	0.42	0.41	0.38	0.41	0.244	*0.784*
Milk Yield per Animal (kg/day)**	2.10	2.07	1.70	1.95	1.495	*0.230*
Producer Milk Sales Price ($/kg)**	0.43	0.44	0.44	0.44	0.275	*0.760*
Total Milk Production (kg/year)**	15 565.00[a]	29 392.85[a]	56 050.00[b]	35 079	22.164	*0.000**
Absolute Profit ($/kg)	0.01	0.02	0.05	0.03	0.259	0.772
Proportional Profit (%)	3.30	5.04	11.91	6.68	0.258	0.773
Income of Milk Sales ($)**	6 833[a]	13 037[a]	24 963[b]	15 577	20.109	*0.000**
Duration of Lactation (day/year)**	210.75[a]	228.69[ab]	239.00[b]	228.15	3.820	*0.026**

*1$= 3.65 TL

**Reference: Gökdai A, Sakarya E (2020): Socio-economic structure and current problems of Saanen goat farms in Çanakkale province. Eurasian J Vet Sci, 36, 72-79.

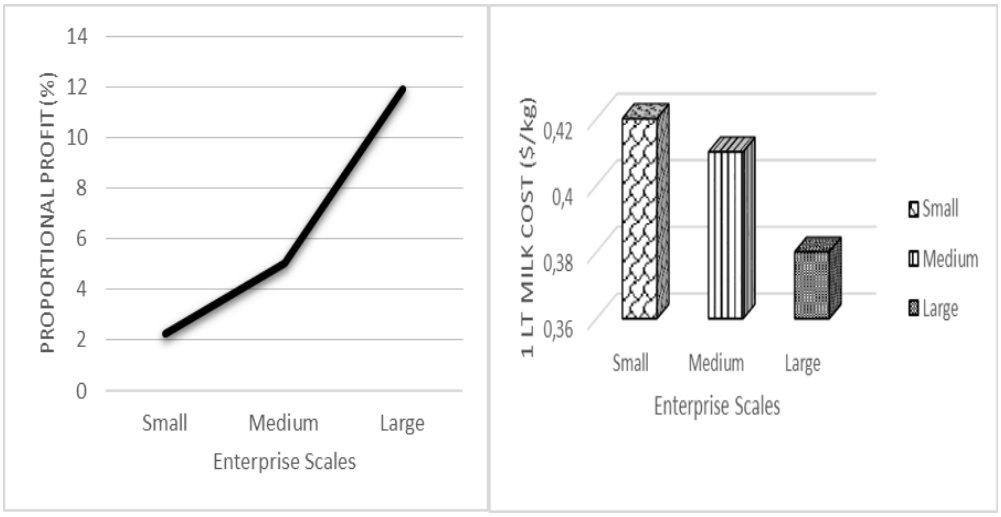

Figure 2. Milk production cost and profitability rates in enterprises.

Table 5. Coefficient of determination (R^2) regarding the last model created, Durbin-Watson value.

Model Summary[i]					
Model	**R**	**R^2**	**Adjusted R^2**	**Standard Error Estimation**	**Durbin-Watson**
Last	0.798[a]	0.636	0.615	34.505	1.739

a. (Constant), Other Costs, Producer Milk Sales Price, Fuel, 1 Lt Milk Cost, Feed Cost
b. Dependent Variable: Total Profit

Table 6. Coefficients in the last regression model.

Parameters	**Multiple Linear Regression Model**			**Collinearity Statistics**		
	B (Standardized)	**Standard Error**	**t Value**	**Sig.**	**Tolerance**	**VIF**
Constant	-	60.491	-1.255	0.213	-	-
Unit Cost	-0.626	4.677	-9.451	0.000	0.965	1.036
Sales Price	0.184	37.259	2.802	0.006	0.977	1.024
Feed Costs	0.208	0.072	2.652	0.010	0.684	1.462
Fuel Costs	0.204	0.815	2.970	0.004	0.900	1.111
Other Costs	0.223	0.341	2.957	0.004	0.742	1.348

Result of Regression Analysis: In regression model it was determined that there was no coefficient of 0.80 or more among the independent variables, and all the independent variables were included in the model**.** Durbin Watson value, which reveals whether there is any autocorrelation among the terms in the model was 1.739 within the 1.5-2.5 coefficients, which was the expected value range.

Table 5 shows that coefficient of determination (R^2) and adjusted R^2 values. Considering the adjusted R^2 value, 61.50% of the changes that may occur in the dependent variable were explained by the independent variables included in the model and 38.50% by the variables not included in the model.

When Table 6 is examined; unit cost, sales price, feed costs, fuel costs and other costs were found statistically significant (P <0.05). VIF values indicating whether there are multiple correlations in the model were expected to be below 10. The fact that all the VIF values in our model were below this value gives the conclusion that there were no multiple correlations.

The formula obtained with the dependent variable Y = Total Profit for the last model was given below.

$$\mathbf{Y= -0.626X_8 + 0.184X_9 +0.208X_1 + 0.204X_5+ 0.223X_7 + \varepsilon}$$

In total profit in enterprises, unit cost (X_8), sales price (X_9), feed costs (X_1), fuel costs (X_5) and other costs (X_7) was found to be statistically significant. If the equation is to be interpreted; providing the other expense items in the enterprises and the factors included in the analysis remain constant, when each independent variable is increased by 0.27 $, respectively, in the total profit; "Feed costs" (X_1) cause an increase of 0.06 $, "fuel costs" ($X_5$) cause an increase of 0.05 $, "other costs" ($X_7$) cause an increase of

0.06 $. It is understood from the equation that when the "unit cost" (X_8) included in the independent variables increases by 0.27 $, there will be a decrease of 0.17 $ in total profit, and when the "sales price" (X_9) increases by 0.27 $, there will be an increase of 0.05 $ in total profit.

Discussion and Conclusion

The cost factors, which have an important share in enterprises, differ in terms of scales. Feed costs with a ratio of 46.22% rank first among the cost elements that constitute the cost factors in enterprises. This was followed by 27.19% labour costs, 5.44% fuel costs and 5.19% veterinarian and health services costs, respectively. In a study conducted in goat enterprises with different scales in Hungary, they found that the most significant share among the cost factors that make up the cost in the enterprises were feed costs in the first place and labour cost in the second place (24).

In a study conducted in sheep enterprises in Muş province, it was revealed that as the scale increases in the enterprises, the unit costs decrease, sales income and profit increase. Similarly to our study, it was reported that if the enterprise scales increase, they can take economic advantage of it (21).

The unit cost of 1 Lt milk was 0.42 $ / kg in small-scale enterprises, 0.41 $ / kg in medium-scale enterprises and 0.38 $ / kg in large-scale enterprises. It was observed that the cost per unit decreases as the scale increases in the enterprises. Along with the increase in enterprise scales, specialization in the product and the use of technology makes it possible to benefit from economies of scale (12).

However, as the enterprise scale increases, the general administrative costs per unit decrease, as in our study; this causes minimization of unit costs and provides more economical management, decision and control tools. As the scale of enterprises increases, the amount of input that the enterprises purchase increases, which leads to an increase in its power in output marketing. Thus, an entity can make discount agreements at input prices, such as purchasing raw materials. This situation causes enterprises to become more economical in terms of unit cost (14).

It was observed that both absolute profit and proportional profit increase as enterprise scales increase in enterprises. These findings support large-scale enterprises with lower milk costs per unit. In a study conducted in goat enterprises in Pakistan's Kohistan region, it was found that the net present value is 29.65% in small-scale enterprises and 46% in large-scale enterprises (1). In a study conducted in dairy goat enterprises in Balıkesir, Çanakkale and İzmir provinces, absolute profit was calculated as 0.24 TL (0.05 $) / kg in small-scale enterprises, 0.57 TL (0.12 $) / kg in medium-scale enterprises and 0.79 TL (0.16 $) / kg in large-scale enterprises. Proportional profit was 18.18% in small-scale enterprises, 46.34% in medium-scale enterprises and 58.95% in large-scale enterprises (15). The increase in absolute profit and proportional profit ratio from small-scale enterprises to large-scale enterprises was similar to the results of our study.

When some milk production values and profitability rates in the enterprises are evaluated by scales; it was determined that the unit cost and daily milk yield per animal decreases as the scale increases. Total milk production and consequently, milk sales income increases as the scale increases, and this difference between the scales was statistically significant ($P < 0.05$). It was understood from the results that the absolute and proportional profitability was directly proportional to the scale of the enterprise.

In conclusion, feed costs were in the first place with the ratio of 46.22% in the distribution of the cost factors. As in other livestock sub-sectors, it is necessary to produce high quality and abundant roughage required for the minimization of feed costs, together with the solution of meadow-pasture shortage problem. On the other hand, as the enterprise scales increase, a decrease in the cost of 1 Lt of milk and an increase in absolute and proportional profits are remarkable. This reveals that large-scale enterprises are more advantageous in terms of profitability.

Besides, there are also some studies indicating that if the necessary technical information and equipment of the increased scale enterprises are not provided, and the enterprise works above its optimal capacity, some management activities can cause mistakes and the administration becomes more difficult; therefore the production and efficiency characteristics of the enterprises decrease (8, 10, 16). Here the important point is what the economic size should be in the classification of the enterprises, and it is an issue that needs to be discussed.

In the regression analysis, it was revealed that the effect of unit cost, sales price, feed costs, fuel costs and other cost factors among the factors affecting the total profit was statistically significant. Similar to our study, in a study examining the profitability of dairy plants by using regression analysis, it was also seen that price of raw milk and dairy products were among the factors that affect the profitability of the enterprise (2). In our study it was observed that feed, fuel and other costs increased by one unit, had a positive effect on the profitability of the enterprise contrary way to the expected. Considering that the data used is the primary data, it is necessary to manage cost factors in the most rational way by the enterprise, taking into account the shares of these independent variables in the total cost elements. In this way, in case the unit cost is reduced, its positive effect on the profitability of the enterprise can be seen.

However, it was inevitable that increasing the unit cost minimization and milk sales price and changing it to a stable structure will have a positive effect on the total profit of the enterprises. Based on this, if we take into account that enterprise owners do not have a right in determining the milk selling price by themselves, it is possible to say that providing unit cost minimization considering also the scale of the enterprise and precautions to be taken on milk price will have a positive effect on the profitability.

In order to increase goat milk production, some structural changes in dairy goat sector are needed in the medium and long term. Small scale, scattered and unorganized goat enterprises in the region, cause a problem in input supply and marketing, which lead to an increase in production costs. As a result, to improve productivity and increase efficiency and profitability, a model should be developed for the growth of small-scale and scattered enterprises by determining the economic herd size in the region.

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Ethical Statement

This study does not require the ethical statement.

Conflict of Interest

The authors declared that there is no conflict of interest.

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